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DEVELOPING PEDAGOGICAL CONTENT KNOWLEDGE OF MATHEMATICS PRE-SERVICE TEACHER THROUGH MICROTEACHING LESSON STUDY

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Abstract

This research aimed to describe pedagogical content knowledge of mathematics pre-service teacher through the lesson study application in microteaching. This descriptive qualitative research was conducted in Universitas PGRI Madiun with Mathematics pre-service teachers as subjects. The data were collected through observation, unstructured interviews, and documentation. Data from learning practice and pedagogical content knowledge were analyzed based on a scoring criteria framework that refers to microteaching assessment guidelines. The results showed that there was an increase in mathematics pre-service teacher learning practice (lesson planning increased from average to good, pre-learning activities increased from average to good, while learning activities increased from average to good, and closing activities increased from average to good). There was an increase in mathematics pre-service teacher content knowledge (increased in concept mastery from average to good and increased in material understanding from average to good). There was also an increase in mathematics pre-service teacher pedagogical knowledge (increased in clarity of learning scenarios from average to excellent, increase in the ability to use learning media from average to good, increase in the appropriateness of assessment techniques with learning objectives from average to good).

Keywords: Pedagogical Content Knowledge, Mathematics Pre-service Teacher, Microteaching, Lesson Study

Abstrak

Penelitian ini bertujuan untuk mendeskripsikan pengetahuan konten pedagogik calon guru matematika melalui penerapan lesson study pada matakuliah microteaching. Jenis penelitian ini adalah deskriptif dengan pendekatan kualitatif. Subjek penelitian adalah mahasiswa calon guru matematika Universitas PGRI Madiun. Teknik pengumpulan data adalah observasi, wawancara tidak terstruktur, dan dokumentasi. Analisis data praktik pembelajaran dan pengetahuan konten pedagogis didasarkan pada kerangka kriteria penilaian yang mengacu pada pedoman penilaian microteaching. Hasil penelitian menunjukkan bahwa ada peningkatan praktik pembelajaran calon guru matematika (perencanaan pembelajaran meningkat dari rata-rata menjadi sangat baik, kegiatan pra-pembelajaran dari rata-rata menjadi baik, sedangkan kegiatan belajar dari rata-rata menjadi baik, dan kegiatan penutup dari rata-rata menjadi sangat baik). Terdapat peningkatan pengetahuan konten calon guru matematika (penguasaan konsep dari rata-rata menjadi baik dan kedalaman materi dari rata-rata menjadi sangat baik). Pengetahuan pedagogik calon guru matematika juga meningkat (kejelasan skenario pembelajaran dari rata-rata menjadi sangat baik, penggunaan media pembelajaran dari rata-rata menjadi sangat baik, kesesuaian teknik penilaian dengan tujuan pembelajaran dari rata-rata menjadi sangat baik).

Kata kunci: Pengetahuan Konten Pedagogik, Calon Guru Matematika, Mikroteaching, Lesson Study

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The problems in mathematics learning are still warmly discussed. Many students in school consider mathematics as a painful lesson and unpleasant. For most students, mathematics is an unattractive and frightening lesson. Students also assume if many math lessons focused on memorizing the formula and useless in daily life. Also, the problem with mathematics is demonstrated by the 2016 PISA

literacy results released in late 2016 (OECD, 2018). From the results of PISA 2015 tests and evaluations, the average score of achievement of Indonesian students for science, reading, and math was ranked 62, 61, and 63 from 69 countries. Mathematics is ranked the lowest when compared with science and reading. Problems with this mathematical achievement indeed cannot be separated from the role of a math teacher in school. So preparing professional teachers is needed starting from the education of mathematics pre-service teachers in college.

Education for pre-service mathematics teacher is essential to be well designed. Procurement must be provided continuously since in the LPTK (Institutions of Teachers and Education Personnel) to increase the competencies of the mathematics pre-service teacher. One of the courses specifically focused on developing pre-service teacher pedagogic competence is microteaching. In this course, students are trained to design and apply to learn in the micro/small classes. In the mathematics education program of the Universitas PGRI Madiun, microteaching lecture innovation has been done through the development of microteaching teaching materials that integrate character and ICT values. The result of the development that the pedagogic competence student mathematics pre-service teacher can be trained well. Students can choose appropriate learning methods and judgments in both design and implementation (Sanusi, Murtafiah, & Krisdiana, 2014).

However, something that emerged lately in the students of mathematics pre-service teacher of the Universitas of PGRI Madiun is the decreasing of their pedagogic competence. Most students are still weak in the mastery of material during teaching practice. Students are less able to deliver mathematical content in a systematic and less able to relate to other mathematical concepts. Also, many students are still confused in determining the method of learning and assessment techniques by predetermined indicators. Students' flexibility in explaining the material must also be trained on an ongoing basis. This shows that content and pedagogical knowledge is still lacking and need to develop this knowledge in pre-service teacher (Kartal, Ozturk, & Ekici, 2012; Shuilleabhain, 2016; Zou & Martinovic, 2017).

Shulman combines the two competencies, namely pedagogic and content knowledge into Pedagogical Content Knowledge (PCK) (Shulman, 1986). PCK is very important owned by pre-service mathematics teacher to maximize the process as well as learning result of mathematics, which is meaningful for the student. The development and exploration of PCK mathematics pre-service teacher have been revealed based on the components of content knowledge, students and pedagogical (Bukova-Güzel, 2010; Maher & Muir, 2013; Aylar, 2017; Widjaja & Stacey, 2009; Martin, Grimbeek, & Jamieson-Proctor, 2013; Leong, Meng, & Rahim, 2015) while several experts have also revealed the importance of mastery of the material/content and learning both for teachers and mathematics pre-service teacher (Niess, 2005; Turnuklu & Yesildere, 2007; Imre & Akkoç, 2012; Lannin et al., 2013; Judson & Leingang, 2016).

The result of this research is the use of technology in preparing the mastery of pedagogical content knowledge for beginner teachers (Niess, 2005). Primary school mathematics teachers should be trained to master pedagogical content knowledge (Turnuklu & Yesildere, 2007). The importance of developing pedagogical content knowledge of primary school mathematics teachers through teaching practice in schools (Imre & Akkoç, 2012). It is important for the pre-service teacher to master the understanding of mathematics and learning (Lannin et al., 2013). The importance of PCK development in prospective teachers in first-year teaching as teaching assistants (Judson & Leingang, 2016).

By Law number 14 of 2015 in Indonesia, a professional teacher must have pedagogical, professional, social, and personal competencies. PCK is an essential component in the development of professional teachers as outlined in The National Science Education Standards (National Research Council in Yuliati, Riantoni, & Mufti, (2018)). Thus, the importance of improving the professionalism of teachers through increased mastery of PCK. Especially as a math teacher, PCK is essential to direct meaningful mathematics learning for students (Subanji, 2013).

An alternative in preparing professional teachers is to improve PCK students' pre-service math teachers through microteaching. Microteaching activity is done with lesson plan pattern. Lesson study is an enhanced learning enhancement that originated in Japan (Yoshida in Lewis, (2002)). The implementation of the lesson plan is emphasized in 3 stages: Plan (plan or design), Do (implement), See (observe and reflect observation result) (Sutopo & Ibrohim, 2006).

Lesson study can improve teachers' ability in developing learning instruments and tools, developing learning methods and models and their application, developing the ability to deliver learning materials and developing the ability to evaluate learning (Marsigit, 2007). Microteaching through lesson study has the potential to improve the ability of mathematics students in designing learning tools and managing learning (Murtafiah, 2016a).

The combination of lesson study with microteaching is called microteaching lesson study (MLS) (Fernandez, 2010). MLS is the application of microteaching through lesson study. MLS provides a context for pre-service teachers to develop pedagogical content knowledge, knowledge of teaching, content, and learning, and images of reform-oriented teaching (Fernandez, 2005). Therefore through MLS, pre-service teachers are expected to improve the material knowledge, pedagogics, and ability in the design and assessment of learning. Some experts have researched microteaching lesson study (Iksan, Zakaria, & Daud, 2014; Kartal, Ozturk, & Ekici, 2012; Fernandez, 2010). The results of the study suggest that microteaching lesson study is effective for improving pre-service teacher skills and professionalism. Lesson study has been implemented on microteaching of learning and curriculum courses at Malaysia University (Iksan et al., 2014). MLS has been implemented to develop a potential teacher of natural science teachers in Turkey (Kartal et al., 2012) while Fernandez (2010)

stated that through MLS mathematics pre-service teacher at the University of Florida the USA can improve knowledge about learning.

From the results of these studies show that there is no research in Indonesia about the development of pedagogical content knowledge of pre-service Mathematics teacher after the application of MLS. This research can also answer Marsigit statement, which states how far lesson study can contribute to its role to support government efforts to improve the quality of teaching at all levels (Marsigit, 2016). So, the purpose of this research is to detect the improvement of pedagogical content knowledge of students of pre-service mathematics teacher of Universitas PGRI Madiun through the application of Microteaching Lesson Study.

Theoretical Framework

Pedagogical Content Knowledge

Lee Shulman was the first to spark the idea of pedagogical content knowledge (PCK) (Shulman, 1986). Shulman identifies PCK as one of the essential knowledge bases that a teacher must efficiently teach (Shulman, 1987). PCK is a particular combination of material and pedagogical content. A specific combination, in this case, is emphasized on the content aspect of the material that is closely related to how to teach the content of such material to be easily explained (teachability) and easily understood by the students (accessible). Knowing a subject for teaching requires more than knowing its facts and concepts (Shulman, 1986).

The PCK component according to Shulman consists of 1) knowledge of the subject matter; 2) knowledge of teaching strategies; 3) knowledge of students' conceptions; and 4) an understanding of what makes learning a particular topic seem difficult or easy for students [3]. The PCK framework used in the study includes knowledge of teaching strategies and some representation, knowledge of students as well as knowledge of the curriculum [4]. Another characteristic of PCK is the combination and refinement of previous theories, namely the Thompson and Lindgren's theory which includes: 1) the component of teaching knowledge; 2) the knowledge component of the students; 3) knowledge component of content (Maryono, Sutawidjaja, Subanji, & Irawati, 2017).

Since the teaching practice of pre-service teacher is done on microteaching, then pedagogical content knowledge (PCK) component that will describe in this study consist of content knowledge (CK) and pedagogical knowledge (PK). Content knowledge includes (1) mastery of mathematical concepts and (2) depth of the matter while pedagogical knowledge includes: (1) clarity of learning scenario, (2) use of instructional media, (3) appropriateness of appraisal technique with learning purpose.

Microteaching Lesson Study

Microteaching Lesson Study (MLS) is a variation of the implementation of a lesson study that combines microteaching with the main elements of the lesson study. MLS can enrich experiences and develop pre-service teacher competence on teaching and learning, to see the relationship between theory and practice (Fernandez & Robinson, 2006). During the implementation of MLS students of prospective teachers tend to be able to explore, analyze, plan, and revise their learning conditions (Fernandez, 2002).

The MLS implementation steps are developed based on Lai & Lo-Fu (2013), as in Figure 1.

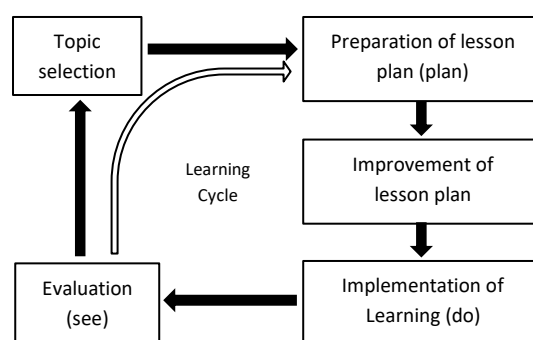


Figure 1. Steps of microteaching lesson study

The topic selection stage aims to make the students of mathematics pre-service teacher do the material selection for the microteaching activity according to the agreement with the lecturer and the team. At this stage, there is also identification and discussion with the team to evaluate and reflect the selected topics. The steps of the preparation of the lesson plan (plan) include discussion activities on the determination of standard competency, basic competencies, indicators, learning strategies, learning medi, and evaluation techniques. Next is the implementation learning stage (do), students who serve as model teachers deliver materials according to the lesson plan that has been prepared with the team. At this stage also designated students as observers who focus on student learning conditions that act as students. The last step is the evaluation stage (see), reflection on the learning process that has been done that begins with what is felt by the student teacher model and continued by the observer. At this stage of discussion discussed the weaknesses and the advantages of learning that are implemented as reflections and improvements to the next lesson.

METHOD

The type of this research is descriptive with a qualitative approach that describes the result of microteaching lesson study implementation. The research was conducted in the department of mathematics education of Universitas PGRI Madiun Indonesia by applying lesson study in microteaching academic year 2018/2019. The subjects were seven students divided into two lesson

study teams. Each team member alternates to the model teacher and other team members as an observer with the researcher, while the other group acts as students. The flow of microteaching lesson study (MLS) activities includes: (1) plan, students with MLS team choose materials and plan/design learning and its tools; (2) do, the model teacher on the MLS team implements the teaching that has been designed, while the team members act as observers; (3) see, reflect the results of implementation and observation. In this research, the team I consist of 3 students, and team II consists of 4 students. MLS was done as much as four rounds so that every student becomes a model teacher four times.

From the series of MLS implementation is then conducted an evaluation of the learning practices and components PCK on the first and last practice. Measurements of learning practices include learning planning, pre-learning, core learning activities, and cover. PCK component is grouped into content and pedagogic knowledge. Mastery of content includes (1) ability of mathematical concepts, (2) understanding of the matte while pedagogical proficiency comprises: (1) clarity of learning scenario, (2) use of instructional media, (3) appropriateness of appraisal technique with learning purpose.

Data collection techniques were conducted by observation, unstructured interviews, and documentation. While the instrument used to measure learning practices and PCK in the form of an observation sheet and documentation tool. Analysis of learning practice data and PCK was conducted based on the scoring criteria framework that refers to the guidance of microteaching assessment in the Universitas PGRI Madiun, which then described a unique thing that happened during the microteaching lesson study.

Table 1. Evaluation Criteria of Microteaching

<i>Criteria</i>	<i>Score</i>
Excellent	3,51 – 4,00
Good	2,76 – 3,50
Average	2,00 – 2,75
Fair	1,00 – 1,99
Poor	0,00 – 0,99

The evaluation criteria in Table 1 are used to assess prospective mathematics teacher students in designing a lesson plan and their application, which includes pre-learning, main of learning, and closing. This criterion is also used to assess content knowledge which includes understanding concepts and mastering material, as well as pedagogical knowledge which includes clarity of learning scenarios, use of learning media, and appropriateness of assessment techniques.

RESULT AND DISCUSSION

MLS is applied to the microteaching group, which consists of 7 students of mathematics pre-service teacher, from now on referred to as S1, S2, S3, S4, S5, S6, and S7. Of the seven students divided into two teams, the team I consisted of S1, S2, and S3. While team II consists of S4, S5, S6, and S7. The technical implementation of MLS can be seen in Table 2.

Table 2. MLS Implementation Techniques

<i>Practice</i>	<i>Team I</i>				<i>Team II</i>			
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
<i>Teacher Model</i>	LS 1: S1	LS 1: S2	LS 1: S3	LS 1: S1	LS 1: S4	LS 1: S5	LS 1: S6	LS 1: S7
	LS 2: S2	LS 2: S3	LS 2: S1	LS 2: S2	LS 2: S5	LS 2: S6	LS 2: S7	LS 2: S4
	LS 3: S3	LS 3: S1	LS 3: S2	LS 3: S3	LS 3: S6	LS 3: S7	LS 3: S4	LS 3: S5
	-	-	-	-	LS 4: S7	LS 4: S4	LS 4: S5	LS 4: S6

From Table 2, it appears that each student of the mathematics teacher performs the practice of teaching microteaching four times. In team I, each practice carried out 3 LS cycles with different model teachers each cycle. Whereas in team II, each practice carried out 4 LS cycles with different model teachers each cycle. To see the development of PCK students of mathematics pre-service teacher during the learning practices that apply MLS, the evaluation of the first and last learning practices is described. In the next section also described the PCK of mathematics pre-service teacher based on the first and last learning practices.

Learning Practices

The results of the first and last practice measurements of learning that include learning planning, pre-learning (preparing students and apperception), main learning activities, and closing activities are presented in Table 3.

Table 3. Practice Score of Learning

<i>Student of Math Pre-service Teacher</i>	<i>Planning of Learning</i>		<i>Pre Learning</i>		<i>Main of Learning</i>		<i>Closing</i>	
	<i>Practice I</i>	<i>Practice 4</i>	<i>Practice I</i>	<i>Practice 4</i>	<i>Practice I</i>	<i>Practice 4</i>	<i>Practice I</i>	<i>Practice 4</i>
S1	2.8	3.5	2.8	3.5	2.7	3.2	2.6	3.4
S2	2.6	3.4	2.4	3.4	2.6	3.3	2.7	3.4
S3	2.5	3.3	2.5	3.5	2.5	3.1	2.8	3.2
S4	2.8	3.5	2.6	3.5	2.6	3.4	2.7	3.3
S5	2.7	3.4	2.7	3.5	2.4	3.3	2.5	3.4
S6	2.6	3.4	2.8	3.6	2.7	3.4	2.4	3.5
S7	2.7	3.3	2.6	3.3	2.5	3.5	2.7	3.4
Average	2.67	3.40	2.63	3.47	2.57	3.31	2.63	3.37

From Table 3 appears that the mean score of lesson planning increased by 0.73 from average (2.67) to good (3.40), pre-learning increased by 0.84 from average (2.63) to good (3.47), core learning activities increased by 0.74 from average (2.57) to good (3.31), and closing activity increased by 0.74 from average (2.63) to good (3.37).

The results were also reinforced by the excerpt of the reflection submitted by one of the mathematics pre-service teacher (S7), "all praises to Allah, I have implemented the lessons according to the ones I have designed with my team. After this practice several times I felt that my ability to design and implement learning is improved. I have grown accustomed to implement consistent learning practices from designing, presenting early learning activities, core learning activities, and closing activities".

In addition, interviews were also conducted on other mathematics pre-service teacher. All students of mathematics pre-service teacher who joined in microteaching lesson study activity give positive responses. Students collaboratively design learning tools, implement, and observe, followed by reflection. Microteaching lesson study is a lecture method that provides an excellent opportunity for pre-service teachers to learn how to teach (Zou & Martinovic., 2017). Through the phase plan in the lesson study stage, planning is done which aims to produce the design of learning that can be learned by students efficiently and foster active participation in education (Sa'dijah, 2010).

This shows that through microteaching lesson study, the professional competence of prospective teachers can develop well. These results are also supported by some previous research (Murtafiah, 2016; Lukitasari, Susilo, & Ibrohim, 2014; Inprasitha, 2014; Wood, 2013; Tall & Arani, 2007; Garet, Porter, Desimone, Birman, & Yoon, 2001). The results of these studies suggest that practical activities and discussions with lesson study teams can develop the professionalism of teachers and pre-service teachers in teaching. Through the implementation of MLS, the implementation of LS can be well structured and systematic. Student teacher candidates can systematically carry out analysis, planning, and evaluate the implementation of learning practices (Fernandez, 2002).

Pedagogical Content Knowledge

In this study, Pedagogical Content Knowledge (PCK) is measured by the component of content and pedagogical knowledge.

Content Knowledge (CK)

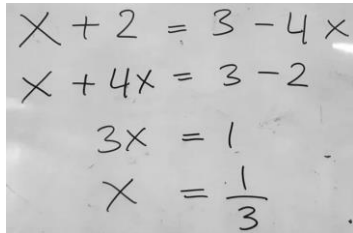
Mastery of content material is assessed based on mastery of mathematical concepts and material understanding that presented in Table 4.

Table 4. Score of content knowledge

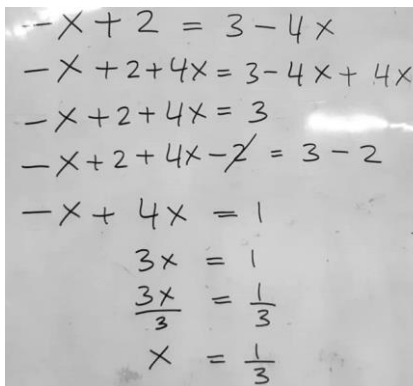
Student of Math Pre-service Teacher	Conceptual Understanding		Depth of Matter	
	Practice	Practice	Practice	Practice
	I	4	I	4
S1	2.6	3.2	2.7	3.3
S2	2.7	3.3	2.7	3.4
S3	2.6	3.2	2.5	3.3
S4	2.8	3.4	2.6	3.4
S5	2.7	3.3	2.6	3.3
S6	2.6	3.2	2.7	3.4
S7	2.5	3.1	2.8	3.4
Average	2.64	3.24	2.66	3.36

The results showed that the average score of understanding of the concept of mathematics pre-service teachers increased by 0.60 from average (2.64) to good (3.24). The average score of material depth also increased by 0.70 from average (2.66) to good (3.36). The understanding of this material appears in the lesson plans that have been prepared in the lesson plan. Through continuous discussion, the understanding of this material is getting better from practice to practice. Not only does it include complete and systematic material as per indicator, but also contains its prerequisite materials. Next will be presented some matters related to the understanding of the concept of prospective students of mathematics teachers.

The increase in mastery of this material is admitted by the pre-service teacher student who is members of the microteaching lesson study as a result of collaborative discussions with his team. However, early in the practice of learning, understanding the concept of mathematics pre-service teacher (S2) is still not yet coherent and complete though at first glance looks correct as in Figure 2a.



(a)



(b)

Figure 2. Explanation of algebraic operation material of math pre-service teacher (S2)

Mathematics pre-service teacher (S2) explains the procedure to solve $x + 2 = 3 - 4x$. In the next step, she wrote $x + 4x = 3 - 2$ by moving $4x$ to the left side and moving 2 to the right side. Those ways are the misconception because of a not complete step in explains to the students (Figure 2a). At the time of reflection activity (see), the mathematics pre-service teacher (S2) get suggestion from the microteaching lesson study team if the explanation of algebraic material to the students should present the concept with coherence and complete.

Furthermore, the mathematics pre-service teacher (S2) accepts that suggestion and completes his explanation as in Figure 2b by adding or subtracting or multiplying same constant or variable in each row. This is because the initial concept given to the students should be a correct and complete concept. Through the concept of a clear and comprehensive beginning is expected to be good and meaningful understanding of students to develop students' thinking skills. Learning should be emphasized in the development of student thinking and not only emphasized in less meaningful procedures (Subanji, 2013).

In addition, the lack of understanding of mathematics pre-service teacher students also occurs in other materials. Some research subjects admitted difficulty with logarithmic materials. At the time of reflection at the beginning of the microteaching lesson study activities, researchers asked questions related to the basic concept of logarithm according to the Figure 3.

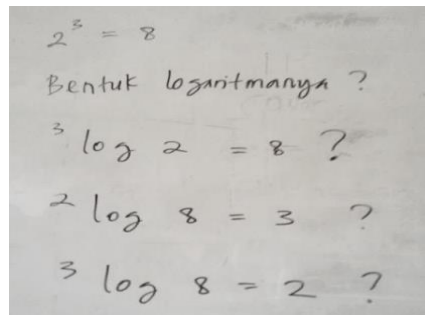


Figure 3. Problems presented by researchers at reflection (see)

Which is the logarithm of the $2^3 = 8$? Students of mathematics pre-service teacher as research subjects began to analyze and looked confused.

R : *"Come on, which is the logarithmic form?"*

S3 : *"The first Mam..."*

S5 : *"The third Mam..."*

R : *"Are you sure?"*

Students of mathematics pre-service teacher are silent, confused, and unable to give a reason related to the answer given. Researchers try to provide some questions to lead to the correct concept.

- R : “Do you still remember, in the form of a power number that is $2^3 = 8$, which is called the base/base number?”
- S5 : “Emmm ... the base number is 2 Mam”.
- R : “Are you sure? So where is the logarithm...”
- S5 : “(think for a moment) Means the logarithm is the second form Mam... which the number 2 is also the base/principal number”.

From the dialogue appears that the student of mathematics pre-service teacher should deepen his understanding and not just memorize. Understanding unfavorable concepts will certainly cause teachers difficulties in explaining to their students. Teachers difficulties affect the learning process and can cause errors in students (Bingolbali, Akkoç, Ozmantar, & Demir, 2010).

Pedagogical Knowledge (PK)

Pedagogical mastery is included: clarity of learning scenarios, use of teaching media, and appropriateness of assessment techniques with learning objectives presented in Table 5.

Table 5. Score of Pedagogical Knowledge

<i>Student of Math Pre-service Teacher</i>	<i>Clarity of Learning Scenarios</i>		<i>Use of Learning Media</i>		<i>Appropriateness of Assessment Techniques</i>	
	<i>Practice</i>	<i>Practice</i>	<i>Practice</i>	<i>Practice</i>	<i>Practice</i>	<i>Practice</i>
	<i>I</i>	<i>4</i>	<i>I</i>	<i>4</i>	<i>I</i>	<i>4</i>
S1	3	3.7	2.9	3.4	2.8	3.2
S2	2.8	3.6	2.7	3.5	2.5	3.3
S3	3	3.5	2.6	3.5	2.7	3.4
S4	2.8	3.7	2.8	3.4	2.5	3.5
S5	2.7	3.6	2.5	3.6	2.7	3.6
S6	2.9	3.7	2.8	3.5	2.8	3.4
S7	2.7	3.6	2.7	3.5	2.7	3.7
Average	2.84	3.63	2.71	3.49	2.67	3.44

Table 4. above shows that the average score of clarity of learning scenario increased by 0.79 from good (2.84) to excellent (3.63), the use of learning media increased by 0.78 from good (2.71) to average (3.49), the appropriateness of assessment techniques with learning objectives increased by 0.77 from average (2.67) to good (3.44).

Students of mathematics pre-service teacher have a good stock on the clarity of learning scenarios. This is because students have taken courses in learning and learning about the various approaches, methods, models, strategies, and steps.



Figure 4. Learning activity (do)

Also, at the beginning of the microteaching lesson study, the students were also able to use the learning media well. This is shown in Figure 5.



(a)



(b)

Figure 5. Use of learning media on the implementation of learning (do)

Students can use the media that has been designed before in the course of learning media workshop. Students can choose the appropriate media to teach specific material.

Furthermore, although there is an escalation in the appropriateness of assessment techniques with the learning objectives of the mid-practice reflection results, there is still a discrepancy between the indicators and the learning objectives of the assessment techniques as in Figure 6.

<p>C. Indicators of Achievement of Competence</p> <ol style="list-style-type: none"> 1. Actively involved in the process of learning sequences and sequences 2. Cooperate in group activities 3. Tolerant to different and creative problem-solving processes 4. Determine integer patterns 5. Determine the formula for the nth term in the arithmetic sequence 6. Generalize the formula for the math term in solving problems related to everyday life <p>D. Learning Objectives</p> <ol style="list-style-type: none"> 1. Have internal motivation, the ability to cooperate, be consistent, discipline, confidence, and tolerance in differences in thinking strategies in choosing and implementing strategies to solve problems 2. Able to transform themselves in behaving honestly, resilient in facing problems, critical and disciplined in carrying out mathematics learning tasks 3. Demonstrate an attitude of responsibility, curiosity, honesty, and caring behavior 4. Students can determine a pattern arrangement 5. Students can determine the nth term formula for an arithmetic sequence pattern 6. Students can apply the formulas found to solve problems related to daily life 	<p>J. Learning Outcomes Assessment Instrument</p> <p>Written test</p> <ol style="list-style-type: none"> 1. Consider the following problem! <div data-bbox="837 280 933 347" data-label="Image"> </div> <p>If the height of one stair is 20 cm, what is the height of the stairs if there are 15 steps? Determine the sequence pattern!</p> 2. Lani is a batik craftsman in Gunung Kidul. He can complete six pieces of batik cloth measuring 2.4 max 1.5 m for one month. Demand for batik cloth has increased so that Lani must provide nine pieces of batik cloth in the second month, and 12 pieces in the third month. He suspects the number of batik cloth for the following month will be three more than the previous month. With this working pattern, in what month did Lani finish 63 pieces of batik cloth? 3. Every day Siti saves the rest of her allowance. The money saved every day for six days follows the arithmetic sequence pattern with the first term $a = 500$ and the difference $b = 500$. How do you know the amount of Siti money saved on the 6th day?
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Figure 6. Indicators, learning objectives and assessment techniques in lesson plan

From the design that has been prepared at the time of this plan, it appears that there is an indicator of the achievement of competence is to determine the pattern of integers that there is no point because the test is written. It indeed provides insight and experience for mathematics pre-service teachers between indicators and learning objectives must be by the assessment instruments used. However, most of the students of mathematics pre-service teachers have been able to develop assessment techniques in the form of a written test by predetermined indicators. The design of writing tests by students has not varied, according to Bloom's taxonomy domain. Most items are made only to the realm of application (C3). Most of the prospective teachers are only able to create one type of essay problem and have not been able to make variations of the matter by the realm of Bloom's taxonomy. Through lesson study activities, it should be designed about the final evaluation that can students' train higher order thinking skills (evaluation, analysis, creation).

The findings of this study are at the beginning of the learning cycle is still found in the lack of certain concepts of mathematics relates to the demands of algebra operating procedures, and the concept of logarithmic numbers. Also, there is a lack of conformity between the design of learning objectives and the chosen form of evaluation. Through the lesson study activities, shortcomings can be improved with the team so that the overall implementation cycle of lesson study in the microteaching course indicates an increase in pedagogical content knowledge as reflected in the improved content and pedagogical knowledge. The results are in line with the statement that the application of microteaching lesson study contributes greatly to the development of pedagogical content knowledge of prospective science teachers (Kartal et al., 2012). In addition, it is also

supported that the application of learning through the pattern of lesson study on TEQIP (Teacher Quality Improvement Program) training can improve pedagogical content knowledge of mathematics teachers as reflected by the increase in mastery of mathematics and pedagogic ability (Subanji, 2015). Also, this is also in line with states the development of teacher knowledge pedagogical content (PCK) during the successive cycle of lesson study by utilizing a framework of mathematical knowledge for teaching mathematical knowledge for teaching (Shuilleabhain, 2016; Ball, Thames, & Phelps, 2008). The application of MLS can increase PCK student candidates in a structured and systematic manner. This is because students of prospective mathematics teachers have made improvements (reflections) in each cycle through the application of MLS (Fernandez, 2002).

CONCLUSION

From the exposure of data of research results and discussion can be concluded the development of pedagogical content knowledge of pre-service students of mathematics teachers. The results can be reflected as follows: (1) there is an escalation in the average score of learning practices: the learning planning increased from average to good; pre-learning activities increased from average to good; core learning activities increase from average to good, and closing activities increase from average to good. (2) There is an escalation in mastery of the content knowledge including the mastery of the concept of being good and the depth of the material increased from average to good; (3) there is an increased mastery of pedagogical knowledge that includes: clarity of improved learning scenarios from average to excellent; the use of enhanced teaching media from average to good; the appropriateness of the assessment technique with the learning objective increased from average to good.

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